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ON THE SOUTHERN EXTENSION OF THE MARION AND WELLINGTON FORMATIONS.

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Read before the Academy, at Topeka, December 28, 1900.

In southern Kansas the Marion and Wellington formations include all the upper Paleozoic rocks between the top of the Flint hills and the base of the Red Beds; or, in other words, between the Chase of Prosser[1] and the Harper of Cragin.[2] According to Cragin's classification, these two formations are included in the upper or Sumner division of the Big Blue series, immediately subjacent to the Cimarron series.

The lower or Marion formation, as first described by Prosser,[3] consists of some 400 feet of rather soft gray or buff, fossiliferous limestone, alternating with variously colored shales and marls. The name is from Marion county, where the formation is well exposed. To the rocks comprising approximately the same formation Cragin afterward applied the term "Geuda salt measures."[4] By the law of priority, however, the first name has continued to be used, and the latter has been dropped from the nomenclature of the region. It is in the Marion that the magnificent salt beds of central Kansas occur, and it is the leaching out of the brine from these beds as they approach the surface to the east that produces the salt-springs and wells along the line of outcrops. Of these, the Geuda springs are perhaps the most noted. The limestones of the lower part of the Marion contain the most typical Permian fauna to be found in the West.

The term "Wellington" was first applied by Cragin[5] to the shales formerly described under the term "gray shales" by Robert Hay. Professor Hay used the term in contradistinction to the "red shales" of the Red Beds further west.[6] The Wellington, as described by Cragin, consists of several hundred feet of gray, red, green and blue shales and clays, containing occasional impregnations of salt, gypsum, and dolomite. The line of separation between the Marion and Wellington has never been sharply demarked. The same difficulties are encountered here as in the classification of the various formations of the Red Beds, viz.: absence of fossils, and such gradual change in the lithological character of the rock that hard-and-fast lines may rarely be drawn.

The line of separation between the Wellington and Harper, in other words, between the Big Blue and the Cimarron, is perhaps more easily located. The change from the gray and blue shales of the former to the prevailingly red sandstone of the latter is comparatively rapid, and in not a few localities the line of division may be definitely located. In a paper describing the stratigraphy of the region of McCann's quarry, near Nardin, Okla.,[7] in which fossils were first found in the Kansas-Oklahoma Red Beds, this fact was emphasized. In this region the green, gray and blue shales of the Wellington are succeeded by a fossiliferous ledge of sandstone three to six feet thick. This ledge, known as the McCann sandstone, is considered the basal member of the Harper, or Cimarron, series. The ledge contains vertebrates, invertebrates, and leaves. The McCann sandstone may be traced for a number of miles throughout Kay and Noble counties, Oklahoma, and serves as a guide for the stratigraphical work of the region.

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[1] Journal of Geology, vol. III, No. 7, pp. 771-786. 1895.
[2] Colorado College Studies, vol. VI, pp. 18-20. 1896.
[3] Loc. cit., pp. 786-789.
[4] Loc. cit, p. 9.
[5] Loc cit., p. 16.
[6] Seventh Biennial Report Kans. St. Bd. of Agr., pt. II, p. 87.
[7] Kans. Univ. Quart., 1900, pp. 175-177.

The base of the Marion is fixed by both Prosser and Cragin at the Winfield concretionary limestone.[8] This is a prominent ledge that extends from Marion county southward, forming the escarpment west of the Walnut river almost from its source to its mouth, as well as numerous mounds and bluffs to the east of this stream. It is well exposed near Winfield and Arkansas City, and extends into Oklahoma as far as the vicinity of Ponca City and White Eagle. The top of the Wellington being at the line of contact of that formation with the overlying Red Beds, it follows that the line of the eastern outcrops of the Red Beds will also be the western limit of the Wellington. The northern exposure of the Red Beds seen by the writer is near Arlington, western Reno county. From this point the eastern limit of these beds may be traced southeast along a line passing near Castleton, New Murdock, Norwich, and Argonia, to the vicinity of Caldwell. In southern Kansas, then, the Marion and Wellington formations occur in the following counties: Western Marion, Butler, and Cowley; practically all of Harvey, Sumner, Sedgwick, and McPherson, and eastern Reno and Kingman. Throughout a great part of this area the Paleozoic is covered with post-Mesozoic formations; notably the Equus beds of McPherson, Harvey, and Reno counties. These formations, however, will not be discussed in this connection.

A glance at the map will show that, along the parallel of the north line of Sedgwick county, the two formations under discussion occupy an area sixty miles wide from east to west. On the state line, sixty-three miles south, the distance across the area is not to exceed thirty miles. It will also be seen that this contraction of area southward is caused by the southeast trend of the line of eastern outcrops of the Red Beds. The Winfield concretionary limestone at the base of the Marion trends approximately north and south.

Bearing in mind the conditions in southern Kansas, we will next turn our attention to the rocks of northern Oklahoma, in order to ascertain whether or not like conditions obtain in this region. As stated above, the Winfield concretionary limestone continues uninterruptedly southward beyond Ponca City. In eastern Kay county it forms the uppermost of a number of heavy flint-bearing limestones, the western extension of the Flint hills, that outcrop along the bluff west of the Arkansas river. To the south the ledge appears to thin out, as do all the limestones of the region, and has not been recognized as far south as the Otoe reservation, although a thin stratum of limestone north of the Otoe agency may be referred to the same ledge. As stated above, the western limit of the Wellington in northern Oklahoma is the line of the outcrop of the McCann sandstone. The most northern outcrop of this rock, so far as known, is on Deer creek, five miles southeast of Nardin, Kay county, and thirty miles southeast of Caldwell, Kan. From this point this ledge has been traced southeast, past the Eagle's Nest quarries, south of Tonkawa, to the vicinity of Redrock, a station on the Santa Fe in the Otoe reservation. The blue and green shales of the Wellington are found, however, as far as Perry and the southern part of Noble county. In the vicinity of Ingalls, in eastern Payne county, thirty miles southeast of Perry, the typical Red Beds shales and sandstones are found in connection with the fossiliferous, flinty limestones, which here represent the southern extension of the Flint hills.

The area of outcrops of the Marion and Wellington formations in Oklahoma, then, may be compared to a right-angled triangle, with the right angle located near Arkansas City, Kan. The state line from Arkansas City to Caldwell is one leg of this triangle, and the line of outcrop of the Winfield concretionary limestone from Arkansas City to Redrock is the other leg. The hypotenuse is along the line of outcrop of the McCann sandstone, from Caldwell to Redrock, a distance of fifty miles. The area occupies the greater part of Kay and a small part of Noble and Grant counties.

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[8] Univ. Geol. Surv. of Kansas, vol. II, 1897, p. 64.

The work already done on the geology of the region is but fragmentary. The data collected on one or two reconnaissance trips, made at various times, constitute almost all of the available information at present. Although no fossils have been found in these formations in Oklahoma, it is now known that the horizons immediately sub- and superjacent contain organic remains; and it is by no means improbable that research will reveal fossils in these beds. The lithological character of the rock is, in some cases, of especial significance. It may often be observed that a shale bed becomes distinctly arenaceous to the south, so much so that in many instances the lithology changes entirely, and the rock will become a true sandstone. Further south in the territory there are several hundred feet of gray and brown sandstones and shales below the Harper, for which the name Stillwater sandstone has been proposed. It may eventually be proven that the Stillwater is but a southern continuation of the Sumner. While no attempt has been made to correlate these rocks with the Texas beds, it may not be considered improbable that future investigation will demonstrate that the Wichita beds south of the Arbuckle mountains are contemporaneous in time with the Salt Fork or lower division of the Red Beds in Kansas and Oklahoma.

The investigations of the Oklahoma Geological Survey during the past summer revealed the fact that the ledges of limestone and shale that form the Flint hills thin out to the south and disappear before reaching the middle of the territory. The culmination of these hills is evidently in eastern Cowley county. Even within Kansas, however, ledges of sandstone appear near the top of the Flint hills. These sandstones become more pronounced to the south, and in the southern part of the Osage nation occupy perhaps half of the thickness of the formations. In eastern Payne county, Oklahoma, and the northwestern part of the Creek country only a few comparatively thin ledges of limestone remain, and in Lincoln county the last of these disappears. Along the line of the North Canadian, from Oklahoma City to Okmulgee, no limestone appears. In this region only sandstones and shales occur.

From what has preceded, it will appear that south of the Kansas line the Carboniferous sandstones from the east and the Red Beds from the west gradually approach each other. At the same time, the Flint hills and the Sumner division become less and less pronounced, until, in central Oklahoma, both of these divisions have disappeared and sandstones and shales occupy the entire area.

THE OKLAHOMA SALT PLAINS.

BY C. N. GOULD, NORMAN, OKLA.

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There are in the Permian rocks of Kansas and Oklahoma two distinctively saliferous horizons. To these Cragin, in his article, "The Permian System in Kansas,"[1] gave the name Geuda salt measures and Salt Plain measures. Prosser's name, Marion,[2] however, had priority over the term Geuda salt measures, and is now in general use.

The Marion formation lies immediately above the Flint hills. It consists of from 400 to 500 feet of saliferous and gypsiferous shales and clays, with a considerable amount of fossiliferous limestone in the lower part. The salt obtained

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[1] Colorado College Studies, vol. VI, p. 9.

[2] Journal of Geology, vol. III, No. 7, p. 786.